## **CLAIMS**

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1. A method for enabling out-of-order processing of contexts by processors of a multiprocessor system, the processors arrayed as a plurality of clusters embedded between input and output buffers, the method comprising the steps of:

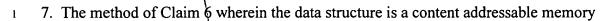
assigning each context a queue identifier (ID) and a sequence number, the queue ID uniquely identifying a flow of the context and the sequence number denoting an order of the context within the flow;

distributing the contexts from the input buffer to the clusters;

allowing out-of-order context processing among the clusters for contexts having different queue IDs; and

enforcing first in, first out (FIFO) synchronization context processing among the clusters for contexts having the same queue ID.

- 2. The method of Claim 1 wherein the step of assigning comprises the step of deriving
- the queue ID using information that enables identification of dependencies among the
- 3 contexts.
- 3. The method of Claim 1 wherein the step of generating comprises the step of trans-
- forming flow parameters of a context to the queue ID in accordance with a hash function.
- 4. The method of Claim 1 wherein the step of assigning comprises the step of increment-
- 2 ing a predetermined value to generate the sequence number.
- 5. The method of Claim 1 further comprising the step of coupling an input sequence con-
- troller to the input buffer and an output sequence controller to the output buffer.
- 1 6. The method of Claim 5 further comprising interconnecting the input and output se-
- quence controllers with a data structure that maintains a list of active flows in the system.



- 2 (CAM) having a plurality of entries.
- 8. The method of Claim 6 further comprising the step of providing a queue field and a
- 2 minimum sequence field within each entry of the data structure.
- 9. The method of Claim 8 further comprising the step of executing an input function at
- the input sequence controller to appliate the data structure with the sequence number and
- queue ID associated with a new context.

10. The method of Claim 9 wherein the step of updating comprises the steps of:

storing the queue ID in the queue ID field of an appropriate entry; and

storing a lowest sequence number of a context for a flow that is active in the sys-

- 4 tem in the minimum sequence field of the entry.
- 11. The method of Claim 10 wherein the step of storing a lowest sequence number com-
- 2 prises the step of setting the content of the minimum sequence field to the assigned se-
- quence number of the first context of a flow.
- 12. The method of Claim 8 further comprising the step of executing an output function at
- the output sequence controller to validate one of the out-of-order processing and FIFO
- 3 synchronization processing of the contexts.
- 13. Apparatus for enabling out-of-order processing of contexts by processors of a proc-
- essing engine, the processors arrayed as a plurality of dusters, the apparatus comprising:
- a hash function adapted to transform flow parameters of a context to a queue iden-
- tifier (ID) that uniquely identifies a flow of the context;

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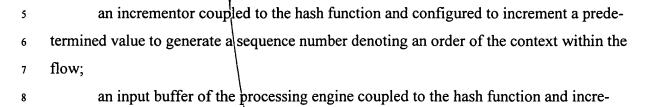
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mentor, the input buffer distributing the contexts to the clusters; and

a sequence control mechanism that allows out-of-order context processing among the clusters for contexts having different queue Ids and enforces first in, first out (FIFO) synchronization context processing among the clusters for contexts having the same queue ID.

14. The apparatus of Claim 13 wherein the sequence control mechanism comprises an input sequence controller coupled to the input buffer and an output sequence controller coupled to an output buffer of processing engine.

15. The apparatus of Claim 14 wherein the sequence control mechanism further comprises a data structure coupled between the input and output sequence controllers, the data structure maintaining a list of active flows in the system.

16. The apparatus of Claim 15 wherein the data structure is a content addressable mem-

ory (CAM) having a plurality of entries, each entry including a queue field that stores the

queue ID of a context and a minimum sequence field that stores a lowest sequence num-

ber of a context for a flow that is active in the engine.

17. A computer readable medium containing executable program instructions for ena-

bling out-of-order processing of contexts by processors of a processing engine, the proc-

essors arrayed as a plurality of clusters embedded between input and output buffers, the

executable program instructions comprising program instructions for:

assigning each context a queue identifier (ID) and a sequence number, the queue

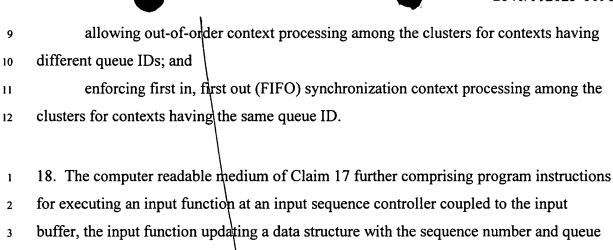
ID uniquely identifying a flow of the context and the sequence number denoting an order

of the context within the flow;

distributing the contexts from the input buffer to the clusters;



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19. The computer readable medium of Claim 18 further comprising program instructions 1

ID associated with a new context, the data structure maintaining a list of active flows in

- for executing an output function at\an output sequence controller coupled to the output 2
- buffer, the output function validating one of the out-of-order processing and FIFO syn-3
- chronization processing of the contexts. 4

the processing engine.

- 20. A method for enabling out-of-order processing of contexts by processors of a multiprocessor system, the processors arrayed as a plurality of clusters embedded between input and output buffers, the method comprising the steps of:
- assigning each context a queue identifier (ID) and a sequence number, the queue ID uniquely identifying a flow of the context and the sequence number denoting an order of the context within the flow;
- providing the queue ID and sequence number to an input sequence controller coupled to the input buffer;
- updating a data structure with the queue ID and sequence number at the input sequence controller, the data structure maintaining a list of active flows in the system;
- processing the context at the processors of the cluster; 11
  - at an output sequence controller coupled to the output buffer allowing one of outof-order processing and first in, first out synchronization processing of the context depending upon the queue ID and sequence number of the context.

